

ABSTRACTS OF PODIUM AND POSTER PRESENTATIONS

Sixty-Eighth Annual Meeting of the American Association of Physical Anthropologists Columbus, Ohio April 26–May 1, 1999

The dentition of modern Finnish peoples. A. ADLER
Dept. Anthropology, Arizona State University,
L. ALVESALO Institute of Dentistry, University of
Oulu, C.G. TURNER II Dept. Anthropology, Arizona
State University

While geographically considered Scandinavians, Finns are linguistically unrelated to other Scandinavians. Instead of belonging to the Indo-European language family, Finns belong to the Finno-Ugric language family. Prior research suggests that modern Finns possess a high frequency of certain morphological dental traits (i.e., shovel and double shovel-shaped maxillary incisors) that are often associated with Asian and Asian-derived populations. Genetic studies, however, show that Finns are more closely related to Indo-Europeans than Uralic (west of the Ural Mountains) peoples, and recent examinations of cranial traits place Finns with Indo-Europeans rather than Uralic populations. Dental morphological data (using the Arizona State University Dental Anthropology system) were collected from a total of 334 dental casts of modern Finns in order to assess if their dental affinities closely resemble modern European populations. For a given trait sample sizes ranged from a high of 253 to a low of 30 with a mean of 160.

When compared to other populations reported in Scott and Turner (1997), Finns are most like other Northern Europeans in frequencies of maxillary central incisor winging, lateral incisor interruption grooves, canine mesial ridge, three-cusped second molars, occurrence of cusp 5, Carabelli's cusp, mandibular 1st molar deflecting wrinkle, Y groove pattern, and 1st molar cusp 7. However, Finns have a far higher frequency of shoveling and double

shoveling than do populations of North or West Europe. Frequency of four-cusped mandibular second molars in the Finns were also lower than the frequency expected for North Europeans. These results show that while Finnish teeth are related to other Scandinavians, they exhibit frequency characteristics of both European and Asian dentitions.

Computational methods for addressing age and sex sample bias: a south-central European Neandertal test case. J.C.M. AHERN. Dakota Science Center, Grand Forks, ND 58206-5023 and Department of Anthropology, University of North Dakota, Grand Forks, ND 58202.

It is widely believed that the evidence for Neandertal ancestry is best in Central Europe. The late Neandertal sample from Vindija (Croatia) has been described as transitional between the earlier Central European Neandertals from Krapina (Croatia) and modern humans. Vindija's transitional status is based to a large extent on frontal bone morphology, which varies significantly with age and sex. Consequently, the morphological differences indicating this transition may be the result of different age or sex compositions between the samples. Using new computational methods, this study tests the hypothesis that the metric differences between the Krapina and Vindija supraorbital samples are due to sampling bias.

Among a sample of recent humans, measurements and characters of the frontal bone were analyzed for covariation with age and sex. For these variables, the shapes of the distributions of the Krapina and Vindija samples were

examined in order to determine the relative degree of age-related sample bias. Furthermore, all possible paired ratios were calculated for the modern human sample and the two Neandertal samples. The confidence limits of the modern human intragroup paired ratios were used to determine which paired Neandertal specimens could be categorized into different age or sex groups.

The results of this analysis demonstrate that young adults are overrepresented among the Krapina frontals, while the Vindija sample has a more equal distribution of young and old individuals. Females are also overrepresented in the Krapina sample. If the Krapina and Vindija samples were drawn from the same population, the overrepresentation of young adults and females at Krapina should make the Krapina remains appear artificially more modern-like. However, the Vindija remains appear intermediate between Krapina and modern humans. Thus, age and sex related sample bias cannot explain the morphological differences between the earlier Neandertals from Krapina and the late Neandertals from Vindija.

Bilateral fluctuating asymmetry in skeletal growth and maturation as an indicator of environmental stress. A.M. ALBERT, Department of Sociology and Anthropology, UNC-Wilmington, NC 28403-3297.

This study examines the efficacy of bilateral fluctuating asymmetry in epiphyseal union as an indicator of environmental stress impacting the skeleton. Stages of union for 17 paired epiphyses from 8 different bones have been documented from a sample of 90 individuals, ranging in developmental age from 11 to 31 years. The skeletons are from two cemetery populations excavated from Medieval Kulubnarti, Sudanese Nubia. Past studies have supported the hypothesis that these ancient Nubians experienced environmental stress—the early Christian period (550-750 AD) population to a greater extent than the late Christian period population (750-1450 AD).

Two mean values were computed for each individual, representative of right-side epiphyseal union and left-side epiphyseal union. These mean values were tested for significant differences. A paired samples t-test revealed that bilateral fluctuating asymmetry was significant for the sample of 90 individuals ($p < 0.02$). This sample was then divided into seven age groups and tested for bilateral asymmetry. Statistical test results showed that 11 to 16 year olds exhibited significant differences in bilateral epiphyseal union mean values. Significant differences are attributed to fluctuating asymmetry resulting from environmental perturbations affecting skeletal maturation.

The development and evolution of relative tail length in *fascicularis*-group macaques (Cercopithecidae: *Macaca*). G.H. ALBRECHT, University of Southern California, Los Angeles, CA 90033, and J. FOODEN, Field Museum of Natural History, Chicago, IL 60605.

The *fascicularis* group of macaques comprise four allopatrically distributed species: *M. fascicularis* (insular and peninsular S.E. Asia: $\sim 10^{\circ}\text{S}$ - 20°N), *M. mulatta* (southern and eastern Asia: ~ 15 - 40°N), *M. cyclopis* (Taiwan: ~ 22 - 25°N), and *M. fuscata* (Japan: ~ 30 - 40°N). This study investigates developmental and evolutionary aspects of the substantial variation in relative tail length that exists within and among these species.

Data on tail length (T) and head & body length (HB) were available for 551 adults and 527 immatures of the four species (only small samples of *M. cyclopis* and *M. fuscata*). Relative tail length ($\text{RTL} = \text{T}/\text{HB}$) was used to compare individuals whose body size varies developmentally, sexually, geographically, and taxonomically. Latitudes of collecting localities were known or narrowly estimated. Polynomial least-squares regression of RTL on latitude was used to characterize the curvilinear relationships that were evident within and among the four species.

The regressions reveal that latitudinal gradients in RTL are remarkably similar among different age classes of *M. mulatta*. However, significant developmental differences exist among infants, juveniles, subadults, and adults of *M. fascicularis*. The regressions for the different ages of *M. fascicularis* are convergent at the extremes of the species ($\sim 8^{\circ}\text{S}$ & $\sim 15^{\circ}\text{N}$) but differ near the equator (~ 0 - 5°N) where RTL decreases progressively with increasing age. These patterns for the two species suggest that developmental changes in body proportions are constrained by environmental effects in non-equatorial regions (e.g., temperature).

Intraspecific and interspecific RTL variation among adults of *M. fascicularis*, *M. cyclopis*, and *M. fuscata* conform to a single gradient of decreasing RTL with increasing latitude consistent with Allen's Rule (i.e., extremities are relatively shorter in colder climates). This generalization holds for *M. mulatta* in the northern part of its range, but it does not apply to *M. mulatta* south of $\sim 26^{\circ}\text{N}$ where the tail is anomalously short ($\text{RTL} \approx 0.4$ is about half that expected). This suggests that the anomalously short-tailed population of *M. mulatta* did not originate within its present range, but dispersed there from further north. Southward dispersal of the anomalously short-tailed *M. mulatta* population, and the correlated extinction of the longer-tailed macaques of the region that the short-tailed population apparently replaced, may have been induced by a major glacial advance.

Patterns of craniofacial variability in three savanna baboon groups. K. ALDRIDGE and J.T. RICHTSMEIER, Johns Hopkins University School of Medicine, Baltimore, MD 21205.

Savanna baboons have been alternatively classified as different genera, different species, or different subspecies of a single species. Their taxonomy is confounded not only by issues of morphology, but also because groups that have been delineated on the basis of morphology are observed to interbreed. Varying taxonomic diagnoses of these groups have been based upon several types of analyses of various data types, including stature, pelage, dental characteristics, and geographic distribution.

This analysis was designed to examine morphological variability of the craniofacial skeleton both within and between three groups of baboons (olive, yellow, and chacma) using Euclidean Distance Matrix Analysis (EDMA). EDMA compares forms quantitatively in three-dimensional space by analyzing all possible linear distances between biologically meaningful landmarks without reference to a system of registration. This method allows for both global and localized comparisons of forms, as well as for ordination of individuals on the basis of morphological similarity. Forty-nine three-dimensional landmarks were collected from the neurocranium and face of male and female adult baboon skulls using a 3Space digitizer.

Our analysis defined localized significant differences between all three groups in the craniofacial skeleton, mainly in the midface and snout regions. As a whole, the skulls of the olive and yellow baboons differ from the chacma baboons in similar ways, which may reflect geographic distribution. This is supported by our observation that chacma baboons from different localities vary in the characteristics that distinguish them from the yellow and olive baboons. Moreover, the patterns that differentiate among the males of the groups are not the same patterns that differentiate the females, indicating different selection pressures on the two sexes. The results of our analyses suggest that the distribution of craniofacial character traits is better defined by ecological boundaries than by taxonomic groupings.

Skull of *Omomyx carteri*, an Eocene omomyid primate. J.P. ALEXANDER and R.D.E. MACPHEE, AMNH New York, NY 10024

Omomyx carteri (Leidy 1869) from the Eocene Bridger Formation, Wyoming, USA, was the first fossil primate taxon described from the Western Hemisphere. The first skull of *Omomyx* AMNH 130000 was discovered in July, 1998 at Grizzly Buttes, Wyoming by B.J. Burger. The material consists of a nearly complete face, a right maxillary dentition, the frontals, a portion of the left posterior basicranium and part of the left dentary.

Because the skull sections were found well preserved, with a calcareous veneer, and the dentary was cemented to the palate out of anatomical position, it is suspected that these remains may be a fossilized owl pellet.

The muzzle of *Omomyx* is proportionately larger than in any other omomyid. Alveoli and roots of I1/ and I2/ are similar in size. The dental formula is I1-2/ C/ P2/-M3/.

The incisive foramina are slightly compressed mediolaterally. As in *Necrolemur* and *Rooneyia*, the large lacrimal foramen is placed anterior to the orbital margin (primitive feature). Although incomplete the orbits appear to be larger and more frontated than in *Tetonius* and *Shoshonius*, giving *Omomyx* a somewhat "lorisoid" appearance.

Although the bulla of the left auditory region has been lost, the promontorial surface appears to be intact and will help to resolve which of the three differing patterns of arterial circulation (cf. *Tarsius*, *Shoshonius*, *Necrolemur*) is primitive for the larger group including Omomyidae and Tarsiidae.

Y chromosome variation in the Hominoidea. T.K. ALTHEIDE and M.F. HAMMER, Department of Ecology and Evolutionary Biology and Laboratory of Molecular Systematics and Evolution, University of Arizona, Tucson, AZ 85721

A comparative framework is developed to study paternally-inherited variation in the Hominoidea. Recent studies of mitochondrial DNA have begun to quantify levels of genetic variation within and between hominoid species. However, mtDNA represents a single locus and reflects only the evolution of the maternal line. Similar studies of other genetic loci are needed to provide a more complete view of the evolution and structure of hominoid populations. Here we report results of a survey of nucleotide variation in a sample of Y chromosomes from *Gorilla gorilla*, *Homo sapiens*, *Pan paniscus*, *Pan troglodytes*, and *Pongo pygmaeus*. Polymorphism was detected in a 900 base pair segment near the sex-determining gene (SRY) in orangutans and chimpanzees. Orangutan populations are not structured with respect to subspecies designation: Bornean Y chromosomes are more distant from each other than they are to Sumatran Y chromosomes. Thus, our preliminary data do not support the mitochondrial DNA-based proposal to elevate *Pongo pygmaeus abelii* and *Pongo pygmaeus pygmaeus* to species status. These initial insights underscore the importance of continued studies of Y chromosome sequence variation in populations of great apes, as well as of variation at other loci in the hominoid genome. Future work will be aimed at testing the hypothesis that contrasting mtDNA and Y chromosome patterns have been shaped by different patterns of male and female dispersal.

Cultural patterning in domestic and other forms of interpersonal violence: Implications for bioarchaeology. A. ALVRUS, Anthropology Department, Arizona State University, Tempe AZ 85287-2402, and P.L. WALKER, Anthropology Department, University of California, Santa Barbara CA 93106.

The issue of prehistoric domestic violence has typically been addressed by reference to skeletal injuries found in females. Parry fractures of the ulna have been suggested as evidence of such violence, as have other fractures

such as broken noses. Complexes of injuries associated with domestic violence have also been described (see Shermis, 1977-1978).

Walker (1997) discussed the concept of cultural patterning in violent behavior, including cultural rules which may structure ways in which wives are beaten. If cultural rules constrain the delivery of injuries during violent disputes, this suggests that the injury pattern for domestic and other forms of interpersonal violence can vary among cultures. If so, the issue of identifying domestic and other forms of interpersonal violence may be more complex than originally perceived.

Our analysis of a large series of modern emergency call records provides clear evidence for ethnic group differences in the pattern of assault injuries. A review of ethnographic descriptions of violence also suggests that there may be cultural constraints on the body parts assailants target. These data suggest that there is an important cultural dimension in the patterning of assault injuries that has implications for bioarchaeological research.

Comparison of genetic and environmental risk factors for lung cancer in three populations. C. I. AMOS, M. R. SPITZ. Department of Epidemiology, UT M.D. Anderson Cancer Center, Houston 77030.

We have collected blood, and demographic and smoking information from 180 Mexican American, 228 African American, and 409 nonHispanic Caucasian lung cancer cases and age-matched controls. Extensive genetic and laboratory analyses have shown consistent differences between cases and controls of each ethnic group with respect to DNA repair capacity, as assessed by exposing cultured lymphocytes *in vitro* to either bleomycin or benzo(a)pyrene diol epoxide (BPDE), a carcinogenic catabolite of tobacco smoke. The adjusted odds ratio associated with bleomycin sensitivity among African Americans was 3.5, for Mexican Americans it was 4.8, with no significant differences among the ethnic groups. In the BPDE assay, there was an odds ratio of 7.3 associating BPDE sensitivity to lung cancer among the three ethnic groups. We also found significant case-control differences between the frequencies of a germline codon 72 p53 variant and polymorphisms of Cytochrome P-450 2E1 but minimal differences between cases and controls for Glutathione-S-Transferase (GST) mu and theta polymorphisms. We propose to contrast results from studies among these three ethnic groups to 1) evaluate dose-related interactions of tobacco smoking behavior with lung cancer risk and 2) identify any significant interactions of ethnicity with

genetically-conferred susceptibility to lung cancer.

Theoretically, individuals deficient for GST, with decreased DNA repair capacity and with risk genotypes for p53 polymorphisms should be at high risk for lung cancer, even with minimal tobacco smoke exposure. Individuals lacking any of these risk factors, similarly should be quite resistant to lung cancer at any level of tobacco exposure. However, for individuals with intermediate genotypes, tobacco exposure is expected to lead to considerably increased risks for disease. Theoretically, then, one anticipates an inverted u-shaped relationship between tobacco exposure and lung cancer risk, among the genetic risk strata. This hypothesis will be evaluated. In addition, we will identify any interactions between lung cancer risk and ethnicity. We also propose to evaluate the proportion of risk that can be attributed to already identified risk factors, versus potentially undiscovered genetic factors.

Primates and other mammals from the Great Divide Basin, SW Wyoming: systematics, geology, and chronology. R.L. ANEMONE, E.M. JOHNSON, and C.M. RUBICK, Western Michigan University, Kalamazoo, MI 49008.

Five summer field seasons in the Great Divide Basin (Sweetwater County, WY) have yielded over three thousand mammalian specimens, including several hundred primates, from 40 localities spanning the Paleocene-Eocene boundary. In this paper we report the results of systematic, geological, and biostratigraphic work at several localities and compare the fossil faunas from the Great Divide Basin with those of other, nearby basins of similar age in Wyoming and Colorado.

Previous work in this basin by Gazin (1962) indicated the presence of Wasatchian (early Eocene) faunas at two localities, Tipton Buttes and Red Desert. We have relocated these localities, collected over 1000 new specimens, and mapped the intertonguing relations of the Green River and Wasatch Formations there, allowing us to more precisely estimate their age based on biostratigraphic and purely stratigraphic criteria. Mudstone overbank deposits and channel sandstones suggest lowland, lakeshore environments, while the faunas point to forested or woodland conditions during the early Eocene. Primates from these localities include adapids (both *Cantius* and *Copelemur*), omomyids (several genera), and microsyopids (*Microsyops*), and they clearly suggest that Red Desert (Graybullian, Wa4-5) is somewhat older than Tipton Buttes (Lysitean, Wa6).

In addition to these (and many other) early Eocene localities, we have collected a late Paleocene (Clarkforkian) fauna for the first time from the Great Divide Basin. This fauna comes from Fort Union Formation sediments in an area known as Ten Mile Draw and is dominated by archaic primates (including two species of *Plesiadapis* and one of *Carpolestes*) and condylarths (*Apheliscus*). The green mudstones, sandstones, and thin but numerous coal beds of the Fort Union Formation also suggest warm, humid, lowland-lakeshore environments of deposition during Clarkforkian times. More derived species of several taxa (especially *Carpolestes*) suggest that this locality is younger than the early Clarkforkian (Cf1) Big Multi site in the Washakie Basin.

The authors thank the Wyoming BLM for their support of this project.

The periodicity of enamel cross-striations based on the developing permanent dentition of known-age children from Spitalfields. D.M. ANTOINE¹, M.C. DEAN² and S.W. HILLSON¹. ¹Institute of Archaeology, and ²Department of Anatomy & Developmental Biology, University College London.

The periodicity of incremental structures in dental enamel is increasingly being used to reconstruct crown growth and dental development in children, which has important implications for the study of human remains and hominid evolution. The method is based on the regular incremental growth of enamel, in which prism cross-striations are believed to represent a circadian rhythm for enamel matrix secretion. Some researchers have argued against the regularity of this growth rhythm. The method, and its precision, were therefore tested on the developing permanent dentition of children whose age-at-death is known from parish records and coffin plates, buried between AD 1729 and 1852 in the crypt at Christ Church, Spitalfields, in London. The interruption to crown formation at death was used to calibrate the periodicity of incremental structures in the enamel. The number of cross-striations between accentuated striae, which were used as landmarks, were very consistent within a tooth and between matched accentuated striae of different teeth from one individual. Cross-striation counts from the neonatal line, marking the point of birth, to the last layers of enamel matrix formed could then be compared with the number of days which had elapsed between birth and death. The cross-striation counts matched known age well. For example, one specimen had a total of 1190 cross-striations and an independently known age-at-death of 1216 days. A slight shortfall was expected due to erosion of the poorly mineralized immature enamel of the growing crown edge, but the match is even closer than anticipated.

These results appear to confirm that cross-striations do indeed represent a regular circadian rhythm to enamel matrix secretion, and that cross-striation counts can be accurately matched within different parts of a single tooth and between teeth of the same individual.

An investigation of structural and functional correlations between cranial characters and character complexes used in the determination of human phylogeny. S. ATHREYA, Washington University, St. Louis, MO 61630, M. CHANG, M. GLANTZ, and M. MURPHY, University of Pennsylvania, Philadelphia, PA 19104.

One of the assumptions inherent in the application of cladistic methodology to phylogenetic analysis is that the characters involved vary independently. The use of characters which are structurally, functionally, or otherwise correlated effectively results in the unintentional upweighting of what should be considered a single character or character complex. While there are a number of different methods for dealing with correlated characters, it is imperative to recognize and treat them explicitly regardless of the method or philosophy chosen to do so.

A number of structural and functional hypotheses have been advanced to explain certain morphologies of the

hominine skull and mandible, but it has been noted that not all of these hypotheses have been rigorously tested. The present study examines the patterns of variation in craniodental and mandibular characters among modern human populations in order to gain insight into the nature of the relationships between characters and proposed structural or functional character complexes. Metric and non-metric traits of the skull and mandible were recorded from a balanced, geographically-diverse sample of modern humans (n=180) including specimens from the Near East, Africa, Alaska, Greenland, northwest Europe, and the southeastern United States. These traits include characters demonstrated to be useful for distinguishing different human populations as well as characters thought to make up a number of functional or structural complexes.

A series of cladistic analyses were conducted using this data for the purpose of tracing patterns of change in individual characters and in putative character complexes. The results of these analyses indicate that correlated patterns of change in certain characters provide support for the identification of structural and functional complexes independent from biomechanical, multivariate, and other kinds of analyses. The implications for character choice and character weighting in phylogenetic analyses of fossil hominine taxa is discussed.

Aspects of social organization in *Microcebus rufus*: results from a long-term mark-recapture study in Ranomafana National Park, Madagascar. S.A. ATSAI, Anthropology Department, Northwestern University at Evanston, IL 60208.

I studied the non-gregarious social organization of *Microcebus rufus*, the brown mouse lemur, a 40 g nocturnal strepsirrhine, through a 16-month mark-recapture trap study in the rainforest of Ranomafana National Park, Madagascar. Trapping permitted me to follow the course of a large number of individuals over an extended period. I examined the composition of the population and the degree of spatial overlap in the ranges of trapped individuals. Although the average number of individuals remained similar, the composition of the population changed from the first year to the second; of the females trapped in the first year, 25% were the same ("resident") during the second year of the study compared to 10% of males.

An average of 8 individuals were captured at each trap suggesting a high degree of spatial overlap. On average each male was captured more frequently (9.8) and at more traps (3.4) than each female (5.7/2.3) suggesting that males range further and/or are more active. Overall (102 vs 72) and on average at each main trap site (5.5 vs 2.4), more males were captured than females. The bias in the trap ratio (averaging 3.7 males to 1 female) occurred primarily from June to September and was the result of trapping marked males and previously uncaptured males. The latter partially replenished the losses in the male population. Thus, population composition and range overlap are highly influenced by the activity of seasonally migrating males.

Ranges of 7 of the 8 resident males overlapped with at least one other resident male. Three of the 11 resident females were relatively isolated from other resident females. Ranges of males were larger but

varied in size, and each male was in contact with at least 2 of the females. One had a large range relatively excluded from the other males with access to 6 of the females.

This study contributes to understanding the factors influencing nocturnal primate social organization.

Funded by NSF 9222699, National Geographic Society 5079-93, Wenner-Gren 5522.

A new look at some old teeth: An analysis of non-metric dental traits in Neandertals and Old World modern humans. SE BAILEY and CG TURNER II Arizona State University, Department of Anthropology, Tempe, AZ 85287-2402

Building on studies that have used non-metric dental traits to assess Late Pleistocene hominid affinities (e.g. Smith, 1989; Crummett, 1995), this study analyzes Neandertal, early modern and recent groups using more non-metric dental traits for assessing biological relatedness.

We have analyzed 23 non-metric dental traits of the Arizona State University dental anthropology system in five samples (fossil data from crown casts of E. Trinkaus). These samples represent European earlier Neandertals (Krapina), European and Near Eastern Neandertals, Near Eastern early moderns, and recent northern European moderns. Biological distance was assessed through the Mean Measure of Divergence (MMD). We also assessed whether a unique suite of non-metric dental traits can be used to characterize Neandertals.

All three Neandertal samples are more like each other than they are like the modern samples. Distances among Neandertal samples are not significant ($p > .05$). However, distances between each Neandertal sample and each modern sample are significant ($p < .05$). Based on MMD values, the Neandertal samples are clearly distinguished from modern samples.

Most Neandertal dental variation can be found in at least some modern human populations. Nonetheless, the results of our trait frequency analysis support earlier findings; they confirm the presence of a distinct Neandertal pattern in both frequency and expression of non-metric dental traits. Still, we did find a trend for more recent Neandertals to show lower frequencies of those traits that make Neandertals unique as a group. Therefore, it is unclear whether these different dental complexes indicate microevolutionary trends. Moreover, the limited scope of this analysis makes it unclear whether the Neandertal or modern human pattern is the more derived one.

Finally, our analysis of the Near East data also supports previous findings that the Near East early modern sample was not biologically closer to the Near East Neandertals as would be expected if the specimens represent one variable lineage.

Contact dynamics in the Northeast and Mid-Atlantic: an overview. B.J. BAKER, Department of Anthropology, Arizona State University, Tempe, AZ 85287-2402.

Recent research on the consequences of European Contact in North America emphasizes the Spanish Borderlands (e.g., Baker and Kealhofer 1996; Larsen in press). These studies utilize a bioarchaeological perspective to investigate the varied responses to Spanish intrusion. In contrast, this symposium focuses on the Northeast and Mid-Atlantic, where English, Dutch, French, Iroquois, and Algonquians vied for power, land and resources.

Contact is viewed in this symposium as a dynamic synergism between disparate groups rather than an act perpetrated upon passive Native Americans by Europeans. This context is integral to the interpretation of change (or lack thereof) in Native American health during the protohistoric and early historic periods. Precontact relationships between indigenous groups in the Northeast and Mid-Atlantic included exchange networks, raiding patterns, political alliances and rivalries. European contact intensified some established patterns and disrupted others. In some cases, Europeans manipulated these relationships to their own advantage.

The goal of this symposium is to place data relating to health status within a diachronic framework in which the prehistoric and historic interaction among native groups, as well as the colonial agenda of Europeans, are seen as contributing factors that shaped Native American responses to contact. General indicators of diet, disease and stress in Native American skeletal samples are used by symposium participants to delineate health status throughout this changing time. In some cases, differences in the frequency of a specific disease (e.g., treponematoses) are used to assess the impact of European contact. These studies, integrated with ethnohistorical data, reveal the mosaic of responses shown by Native groups to European intrusion into the Mid-Atlantic and Northeast.

Introduction—Childhood nutrition and health in prehistory. J. BAKER & L. WRIGHT, Department of Anthropology, Texas A&M University, College Station, TX 77843-4352

Recent research in bioarchaeology has begun to develop diverse approaches to the biocultural study of childhood nutrition in the past. Infancy and early childhood are critical years for growth and development during which cultural ideals about child feeding, food choices, and household economic factors can have profound consequences for the health of children. Ultimately, childhood nutrition is directly linked to survivorship and the demographic structure of a population.

Focusing on methodological advances in the bioarchaeological study of early childhood nutrition, this session will include a combination of paleodietary, paleopathological and skeletal biological research from varied regions of the world. In the introductory paper, we outline some of the biocultural parameters that can now be addressed with a variety of biochemical and paleopathological techniques.

Previous research on early childhood health focused primarily on evidence for periods of ill health, and on the reconstruction of levels of childhood mortality through demographic profiles. The development of chemical methods which can be used to reconstruct paleodiets has allowed researchers to examine the nutritional underpinnings of infant health. In particular, the application of stable nitrogen isotopes to study prehistoric weaning practices has shed light on cultural variability in early childhood diets. Additional isotopes, elemental ratios, and age-specific dietary records found in teeth now augment the paleodietary tool kit. This increasing attention toward defining age-related changes in infant nutrition will soon allow greater integration of data concerning changes in infant diets and paleopathological indicators of health.

Developmental changes in the petro-occipital fissure: Implications for age estimation and biomechanical relationships. A.L. BALBONI, J.S. REIDENBERG and J.T. LAITMAN, Depts. of Cell Biology/Anatomy and Otolaryngology, Mount Sinai School of Medicine, New York, NY 10029.

The petro-occipital fissure (POF) lies within an important interface of cranial growth and development. The relationships between skeletal and soft tissues make this region especially important for examining biomechanical and basic biologic forces which mold the cranial base. Although of significant importance during growth and development, little attention has been focused on assessing age related changes to this important region. Therefore, this study investigates the POF in order to determine if developmental changes can be observed and, if so, their value in age assessment.

Observational analysis was conducted on extant crania in order to define and describe developmental changes to the POF. 200 extant crania of known age and provenience from the University of New Mexico Maxwell Museum (UNM Maxwell Museum) were studied. Results show that characteristic changes of POF ossification allow for sorting of crania by age. Degrees of ossification could be categorized into six general stages from stage 1 (least ossified) through stage 6 (complete ossification of the POF).

To test the possible value of POF ossification in age assessment, data were collected from 120 contemporary skulls from UNM Maxwell Museum. Each skull in this sample was assigned a random identifying number and was of known age and provenience. This blind sample was chosen randomly, without replacement and without regard to age, sex or ethnicity and is representative of contemporary New Mexico populations (e.g. Caucasian, Hispanic, and Native American). The degree of POF

ossification was scored independently by two examiners according to the staging system. Results show a correlation between age and stage of POF ossification ranging from .526 to .807 (significant at the .01 level). Male crania were observed to reach greater degrees of fissure ossification at a younger age than female crania in our sample. The data showed significant differences when sorted by sex. Male correlations ranged from .413 to .737 and female correlations ranged from .706 to .938 (significant at the .01 level). Individual asymmetry in POF ossification was noted in both male and female crania.

This study reveals both the significant age graded changes to the POF and the value of this region in age estimation. Further studies will explore changes in the POF and its relationship to the basi-cranium during growth and development.

Origins and affinities of tribal populations in South India. M. BAMSHAD¹, W.S. WATKINS¹, M.E. DIXON¹, B. BHASKARA RAO², J.M. NAIDU³, B.V.R. PRASAD⁴, P.G. REDDY⁵, P.K. DAS⁶, P.C. REDDY⁷, P.B. GAI⁸, A. BHANU⁹, M.F. HAMMER¹⁰, A. RASANAYAGAM¹⁰, and L.B. JORDE¹. ¹Department of Human Genetics and ²Department of Pediatrics, University of Utah, Salt Lake City, Utah, 84112; ³Department of Anthropology, Andhra University, Visakhapatnam, India; ⁴Anthropological Survey of India, Mysore, India; ⁵Department of Anthropology, University of Madras, Madras, India; ⁶Department of Anthropology, Utkal University, Bhubaneswar, India; ⁷Department of Anthropology, Sri Venkateswara University, Tirupati, India; ⁸Department of Anthropology, Karnatak University, Dharwad, India; ⁹Department of Anthropology, University of Calicut, Kerala, India; ¹⁰Laboratory of Molecular Systematics and Evolution, University of Arizona, Arizona.

There is substantial evidence of pre-historic migrations of populations between continents bordering the Indian Ocean. As a consequence of gene flow and admixture with migrants, it has long been speculated that tribal populations of South India vary in their affinities to Africans, Asians, and Australian aborigines. Indeed, morphologic similarities to continental populations remain the basis of the classification of South Indian tribes. Nevertheless, there are limited genetic data that support such conclusions.

We have sequenced 400 bp of mtDNA HVS1 from 250 individuals in 15 tribal populations living in South India. Within-group genetic variation differs significantly among tribes. More than one quarter of the genetic variation is distributed between tribal groups ($G_{ST}=0.27$). In a neighbor-joining network tribal populations are separated by long branch lengths, although groups living in the same geographic area cluster together. Affinities to continental populations differ between tribal populations, but are not consistent with morphology-based classifications.

Affinities of tribal groups to South Indian caste populations vary with caste status. This is consistent with immigrating Central Asians making a proportionately larger genetic contribution to the upper castes, while indigenous populations were likely sorted into middle and lower caste groups. Lower average (0.011) heterozygosity and greater G_{ST} than castes suggests substantially more genetic drift in tribal populations.

Anthropometric and biomechanical assessment of skeletal structural adaptations during the postcontact period in Michigan. D.A. BARONDESS, Wayne State University, Detroit, MI 48202.

This research investigates postcranial skeletal structural adaptations in bioarchaeological populations from Michigan. It accomplishes this by examining differences in long bone structure that may have coincided with changes in physical activity between the prehistoric and historic periods.

Two separate data sets are utilized. One set is derived from a whole bone anthropometric analysis of external bone dimensions, the other is derived from a biomechanical analysis of computerized tomographic (CT) scan-generated diaphyseal cross-sectional size, shape, and strength properties.

Results of this research demonstrate significant differences in the femoral and humeral dimensions and biomechanical properties between the prehistoric and historic period groups. For both males and females, most measures of diaphyseal size are smaller in the historic period. Alternatively, the diaphyses are significantly stronger, arguing for increased biomechanical demand, for both sexes, in the historic period. The magnitude of the femoral cross-sectional size and strength differences between the two periods is greater for females than for males, suggesting that the level of physical activity changed more dramatically for females.

With the aid of archaeological and historical documentation, patterns of physical activity and their potential behavioral correlates within the context of culture contact are also examined. Specifically, the impact of the fur trade on the Native American subsistence economy, especially as related to the changing role for females during the historic period, is addressed. Results are evaluated against research from other regions of North America, where similar analyses have brought to light the general patterns of skeletal adaptation that can be expected from modifications in physical activity in a wide range of biocultural contexts.

This research was supported in part by NSF grant BNS 9011522.

Incisor labial wear striations in modern humans and inferences for behavior in Middle and Late Pleistocene hominids. J.S. BAX, Anthropology, University of Colorado, Boulder, CO 80309, P.S. UNGAR, Anthropology, University of Arkansas, Fayetteville, AR 72701.

Several authors have argued that the incisors of Middle to Late Pleistocene hominids show wear scratches attributable to stone tools crossing the front teeth during "stuff and cut" behavior (Brace, 1962). They have further reasoned that orientations of striations on incisor labial surfaces indicate handedness. In the present study, we examine similar striations on the incisors of anatomically

modern humans to determine whether handedness is reflected in scratch orientation preferences. Individuals (n=66) representing four Amerind groups (Aleut, Arikara, Illinois Bluff, and Puye) were considered, and photomicrographs were taken of the labial surfaces of the maxillary central incisors of each specimen at 56x magnification. Orientations of all visible striations were then measured using Microware 3.0, and analyzed using statistical procedures designed for the analysis of circularly distributed data (Batchelet, 1981). Most (74%) of the surfaces showed a preferred apico-cervical orientation, regardless of cultural affiliation. In fact, few showed the predominantly diagonal orientations expected if these features are affected by handedness. We found no evidence for "stuff and cut" activity, despite the fact that at least one of the groups studied, the Aleut, are known to have used this behavior. We conclude that, if Middle and Late Pleistocene hominids used their teeth in a manner similar to that of the groups considered here, it is unlikely that labial scratch orientation distributions reflect handedness in these fossil taxa.

Oxygen saturation and the response to sub-maximal exercise among Tibetans at 3900m. C. M. BEALL, Anthropology, Case Western Reserve University, Cleveland, OH 44106, C. M. WORTHMAN and J. STALLINGS, Anthropology, Emory University, Atlanta, GA 30322.

High altitude natives exhibit a wide range of variation in physiological hypoxia measured as the percent of oxygen saturation of arterial hemoglobin (SaO₂). Substantial variance in resting SaO₂ among Tibetan high-altitude natives is attributable to a major gene with an autosomal dominant mode of inheritance for an allele for 5-6% higher SaO₂. To address the general hypothesis that higher SaO₂ confers a functional advantage under naturalistic conditions, this report presents the results of a test of the specific hypothesis of a positive association between resting SaO₂ and SaO₂ measured in the last minute of a sub-maximal exercise test.

The sample was drawn from rural villagers in Pembo, Lhasa Municipal District, Tibet Autonomous Region, China, at 3900m. 271 high-altitude native ethnic Tibetans 14-55 years of age provided sub-maximal exercise test data using the protocol of the modified Canadian Aerobic Fitness Test and attained 85% of their age-predicted maximal heart rate. Resting SaO₂ was measured by pulse oximetry under standardized conditions one to ten days prior to the exercise test. SaO₂ was monitored throughout the test and recorded in the last minute of each three-minute exercise stage.

Average age was 27 ± 10 years, average resting SaO₂ was $90 \pm 2\%$ and average SaO₂ in the last minute of exercise was $86 \pm 4\%$. These traits did not differ by sex. Resting SaO₂ was associated with SaO₂ at the end of exercise ($r = .39$, controlling for age, $p < .05$). A 5% higher resting SaO₂ predicted a 3.1% higher SaO₂ at the end of exercise. These findings suggest that a benefit of higher resting SaO₂ is maintenance of greater SaO₂, less hypoxic stress, and the potential for better oxygen

delivery to tissues during sub-maximal exercise similar to that experienced during everyday activities. These findings suggest the hypothesis of a Darwinian fitness advantage for those with the allele for higher SaO_2 .

Supported by NSF Award No. SBR9706980.

A field method for the assessment of gonadal, adrenal, and ovarian function in baboons using fecal steroid analysis. J.C. BEEHNER, J.E. PHILLIPS-CONROY, T.J. BERGMAN, Departments of Anthropology and Biology, Washington University, St. Louis, MO 63130, C.J. JOLLY, Department of Anthropology, New York University, NY 10003, and P.L. WHITTEN, Departments of Anthropology and Biology, Emory University, Atlanta, GA 30322.

Field endocrinology is a relatively new approach in primatology and behavioral ecology. While previously only possible in captive settings, recently developed non-invasive methods which extract steroids from fecal samples (Wasser *et al.* 1988, 1991; Strier & Ziegler 1994; Shideler *et al.* 1994; Stavisky *et al.* 1995; Brockman *et al.* 1995) allow hormone levels to be ascertained from fecal samples of free-ranging animals. Current methods of fecal steroid preservation require freezing, oven-drying, or steroid extraction within two hours after sample collection. Such immediate processing of samples is not always possible when simultaneous behavioral observations are being collected. This study expands upon methods already established for fecal sample collection and steroid extraction and reports a technique that preserves steroids when there is a time lag between collection and extraction. Additionally, this method provides a useful alternative to freezing in sites where electricity or liquid nitrogen is not available.

The field study was conducted on a troop of hybrid baboons (*Papio hamadryas anubis* x *P. h. hamadryas*) in the Awash National Park, Ethiopia. The target animals were four females at various reproductive stages. Early morning fecal samples were collected approximately every three days over a two month period yielding a total of 58 samples. Extractions were done in the field, using a technique that recovers fecal steroids using solid phase extraction with methanol (Stavisky *et al.* 1995). All extractions were performed 12 hours after sample collection. Following extraction, samples were stored in sterile Whirl-Pak bags at room temperature. Laboratory radioimmunoassay procedures were carried out 1-2 months later on samples to measure levels of estradiol, progesterone, testosterone, and cortisol. The immunoassays for these four hormones have been previously validated for fecal steroids extracted from free ranging yellow baboons (*Papio hamadryas cynocephalus*) (Stavisky, 1994). These protocols were shown to be highly specific (Stavisky, 1994). This study confirms that this method can be used to monitor ovarian, gonadal, and adrenal hormone profiles in free ranging hybrid baboons (*Papio* spp.).

Can weaning age of infant primates be approximated using interbirth interval-gestation length? B. BEHRENS, University of New Mexico, Albuquerque, NM, 87131.

In several primate interspecific analyses, infant age at weaning has

been approximated through infant age at mother's estimated reconception (interbirth interval - gestation length). This study compares weaning ages (cessation or very low level of lactation) to reconception data for anthropoids published by Lee *et al.* (1991), and reconception data for anthropoids and prosimians derived from my own reading of the literature. Using non-parametric methods, comparisons are performed at the species and the family level.

Within anthropoids, reconception and weaning are not significantly different from each other (signed rank test, $\alpha = 0.05$). The Spearman correlation coefficients between them are over 0.84 (among species) and 0.77 (among families). However, variation in the relationship between reconception and weaning might be of biological significance. Bias ((reconception - weaning)/weaning) based on my reconception estimate is positively correlated with cranial capacity and body mass.

Within prosimians, at the species and the family level, reconception and weaning ages are uncorrelated; reconception significantly postdates weaning. Two groups are influential: Cheirogaleids reconceive long after weaning, possibly due to strong seasonality. Most loroidae reconceive before weaning, which is interpreted as late weaning to a noxious adult diet.

Though reconception and weaning age are very similar in most groups, this does not mean that they should be used interchangeably. The exceptions to this similarity, as well as the significantly higher variance of reconception, indicate that reconception is ecologically more sensitive.

Individual Variation in Growth and Body Composition in a Group of Captive Infant Gorillas (*Gorilla gorilla*)

A. BELLISARI, C. GREENBERG and B. TOWNE, Department of Sociology and Anthropology and Department of Community Health, Wright State University, Dayton, OH 45435

In order to describe overall patterns of infant gorilla growth and body composition, a longitudinal series of morphometrics from a group of six gorilla infants reared in the Columbus (Ohio) Zoo nursery are analyzed. The group includes two sets of full siblings - a pair of male twins and a male-female pair. All six infants have one set of grandparents in common. Nursery records show that the single female and two of the males suffered from intestinal symptoms of varying duration and severity. Growth curves are fitted to observed data for cephalo-thoracic-abdominal (CTA) length, total arm length, total leg length, weight, upper arm circumference, and head circumference.

Two patterns of growth, one more curvilinear and one less curvilinear, describe the infants' skeletal growth. The CTA length and limb length curves for the twins are virtually identical. The intermembral index for the group remains at 100 throughout the first year. Although the birthweight of all infants is similar, differences in weight are apparent by day 30. Curves for weight and upper arm circumference reflect health status, while weight

curves also appear to vary by sex and heredity. Head circumference growth is less variable, although sex difference is apparent during the first year. Relative skeletal growth patterns are consistent with relative body composition patterns in the group.

Both environmental and genetic factors seem to influence the first-year growth of this group. Reduced growth rates reflect illnesses episodes. The female's growth patterns diverge from those of the males, and the twins' patterns are nearly identical, although it cannot be determined whether the similarity is due to shared heredity or shared environment. In spite of its limitations, the results of this study show that variations in individual growth patterns can be identified through analysis of infant gorillas' serial data. However, such data are rare and not readily available.

Many thanks to the administration and staff of the Columbus Zoo for their assistance and cooperation.

Analysis of dental remains from Honduran ossuary caves. D.C. BENEDIX¹, N.P. HERRMANN¹, VA HASKINS², and L.E. FLOURNOY¹. ¹Department of Anthropology, University of Tennessee, ²Department of Social Sciences, Adirondack Community College.

Over the last decade several burial caves have been identified and investigated in Mesoamerica. In this study, we discuss the dental remains recovered from two ossuary caves located in the Olancho Valley of northeastern Honduras near Catacamas. The caves are Cueva del Rio Talgua (Cave of the Glowing Skulls) and Cueva de las Arañas (Cave of the Spiders). Recently, the Cave of the Glowing Skulls was featured in *Archaeology* (1995). Since that time, Dr. James E. Brady of California State University-Los Angeles and a multidisciplinary team of investigators conducted extensive research on the archaeological context of the Rio Talgua area and the caves. As part of this project, all *in situ* and disturbed human remains were inventoried and analyzed in the caves. The Honduran Government graciously allowed sampling of loose dental remains encountered during field analysis.

All teeth were identified and assessed following the *Standards for Data Collection* (1994). Several modifications were made to the data collection system to facilitate efficient and accurate analysis. Information from *in situ* remains was combined with the data from our recent analysis of the loose teeth. An overall inventory was generated based on this composite set. The entire sample consists of 714 teeth. All demographic age groups are represented in both caves, but subadult material comprises only a small percentage of the total tooth sample. Premolars and molars predominate the adult dentition.

Pathological conditions documented in the sample include caries, linear enamel hypoplasias, alveolar resorption, and periapical abscessing. Overall, 12% of the teeth have carious lesions. As expected, these defects were more frequent in posterior teeth. Enamel defects were observed in 14% of the sample.

In addition to pathological data, we examined an artificially modified tooth from the vestibule of Arañas. Furthermore, the mtDNA hypervariable region from several teeth has been sequenced successfully.

Mandibular evidence bearing on the phylogenetic position of *Victoriapithecus* and its relationship to *Prohylobates*.

B.R. BENEFIT. Department of Anthropology, Southern Illinois University, Carbondale, IL 62901

Since 1987, 56 mandibular fossils of *Victoriapithecus macinnesi* have been recovered from middle Miocene deposits on Maboko Island, Kenya, bringing the total collection to 74. The new specimens include five nearly complete mandibles, which are the first to preserve the symphysis and both sides of the corpus. Three of these preserve substantial portions of the ramus, and one also preserves the coronoid process and condyles.

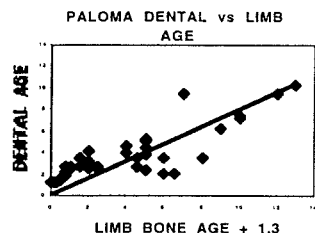
Prior to discovery of the new specimens, the symphysis of early and middle Miocene victoriapithecids was known from only two specimens of *Prohylobates* from Buluk and one of *Prohylobates* from Wadi Moghara. The configuration of the *Prohylobates* inferior transverse torus is unique among cercopithecoids, resembling neither that of cercopithecines which forms a simian shelf, nor that of colobines which bulges between the genial pit and origin of the digastrics. Rather than resembling *Prohylobates*, the symphysis cross section of *Victoriapithecus* is identical to that of cercopithecine monkeys in having a simian shelf. This discovery warrants maintaining *Victoriapithecus* Von Koenigswald 1969 as a genus distinct from *Prohylobates* Fortau 1920 as known both from the type material from Wadi Moghara and referred specimens from Buluk.

It does not support interpretation of the unusually vertical inferior torus of *Prohylobates* as a derived condition shared by all victoriapithecids (Benefit 1985, 1987; Fleagle 1988).

As for other aspects of *Victoriapithecus*' morphology, its mandible is characterized by a combination of cercopithecine-like, colobine-like and unique features. The coronoid process of the *Victoriapithecus* mandible is highly unusual and resembles that of only *Aegyptopithecus* among catarrhines in being much higher than the condyle. As predicted from fragmentary pieces, the ramus of *Victoriapithecus* resembles colobine monkeys in being fairly vertical, but is wider antero-posteriorly than that of many extant species. The height of the corpus below M2 relative to the length of the molar row is similar to that of many colobines (*Colobus badius* and *Nasalis larvatus*), and some cercopithecines (*Macaca fascicularis mordax*).

Keeping alive children who are failing to thrive in an Archaic fishing village in Coastal Peru. R.A. Benfer, Department of Anthropology, University of Missouri-Columbia, MO 65211

Dental age more nearly reflects chronological age than age estimated from the limb bones of children. The figure shows that individuals who died at the earliest ages had shorter limbs for their dental age than those



who lived longer (limb age estimates were adjusted upwards 1.3 years, the average difference between the two methods). Individuals with unusually low limb length estimated ages, that is, with unusually short limb lengths for age, show other pathological conditions, such as increased anemia as evidenced from cribra orbitalia. Evidence that is presented for delayed marriage, low fertility, and female infanticide suggests that many of the early deaths are girls, a result of greater parental investment in boys. Surprisingly, some children, failing to thrive, were kept alive. A somewhat different pattern is observed when the Paloma, Archaic fishing village series is compared with the Villa El Salvador early farming series from the same general area.

Growth of 19th Century Native American from the Great Plains. J.L. BENNETT and R.L. JANTZ, Department of Anthropology, University of Tennessee, Knoxville, TN 37996-0720

Although human growth follows a general pattern, population specific rates and timing are strongly influenced by both genetic and environmental factors and their interaction. Consideration of the tempo of growth within a population is crucial for interpretations of human adaptation such that the generation of population specific standards of growth is a crucial endeavor. The present investigation considers the rates of growth in height across several temporally and geographically separate populations utilizing anthropometric data on children ranging in age from 4 to 21 years. A comparison of growth curves for several spatially and temporally separate populations will illustrate variation in physiological patterns of development and illuminate potential biological responses resulting from environmental stressors.

Anthropometric data on approximately 1500 children representing four groups was utilized. Measurements of Native American Plains tribes, both equestrian and village, collected by Boas, and 19th and 20th century European American school children were evaluated. Standing height, sitting height and subischial height were subjected to graphical and statistical analysis.

Results indicate that all 19th century groups demonstrate equal growth until the midchildhood period (11-15 years), at which point Native American groups experience growth retardation. This disparity is compensated for by continued growth during the late teen years (17-20 years). Slight differences are

apparent between village and equestrian tribes. As anticipated the 20th century population exhibit greatest standing and subischial heights.

The generation of population specific growth profiles is appropriate for accurate anthropological interpretation and comparison of varied groups and cultures. Further, it is anticipated that results of the present investigation can be used to assess the precision and utility of Native American growth curves derived from skeletal and dental ages.

Comparisons between Island and Mainland Dwelling Populations of Mona Monkeys in Africa and the Caribbean. BENSEN, K.J., and GLENN, M.E. Windward Islands Research and Education Foundation, 11 East Main Street, Suite 154, Bayshore, NY 11706, USA.

Approximately 300 years ago, during the African slave trade, a small number of mona monkeys (*Cercopithecus mona*) from mainland Africa were introduced to the Caribbean island of Grenada and the Gulf of Guinea islands of São Tomé and Príncipe. The monkeys have since become naturalized and have greatly increased in number. Introduced island populations such as these can provide models under which the possible effects of (1) isolation and severe population reduction, and (2) living in a radically new environment may be examined by comparing various natural history and ecology characteristics of the island populations to those of mainland populations of the same species. From 1992 to 1995, we examined the population density, social structure, vocal repertoire, morphology, and habitat use of the Grenada mona monkey population. We are currently examining the same parameters in the São Tomé and Príncipe monkeys. Preliminary comparisons between our data and those published in the literature on mainland African monas have revealed differences in social structure, vocal repertoire, morphology and habitat use. These differences may be due to genetic drift caused by reduced genetic variability or may be the result of ecological adaptations. However, the data available for mainland monas are scarce and mainly from Cameroonian populations; further research is needed across the entire mainland range before dismissing intraspecific variation as a cause of these apparent population differences.

A Better Approach to Analyzing Prehistoric Human Remains: The Advantages of Using Both Field and Laboratory Analyses. GE BERG and PD MINTURN. Archaeological Consulting Services, Ltd., Tempe, AZ. 85282, Bioarch, Payson, AZ. 85541, and Arizona State University, Tempe, AZ. 85281

Field analysis of human remains often gathers different data than laboratory analysis for the same

population. To better understand the dynamics of those data, field and laboratory analyses of 400 prehistoric human burials were compared, using the categories of age, sex, pathology, and long bone metrics. The study populations originated from several large CRM projects in the Tonto Basin and Globe Highlands of central Arizona, and dated to A.D. 1100-1350.

As expected, age categories were refined in the laboratory from the field estimates. Sex estimates in the laboratory were more accurate, but field data was pivotal in defining sex estimates in complex cases. In several instances, field photographs of bone *in situ* helped as well. Pathology and trauma diagnosed in the field were under-representative of the population disease load, but many fragile bony responses and several fractures did not survive transfer to the laboratory setting. Long bone measurements taken in the field outnumbered the laboratory measurement nearly 3-to-1. When duplicated, each set was within a reasonable deviation of the other.

It is our contention that field and laboratory analyses are best used in tandem, as each has strengths and weaknesses mitigated by the other. As shown by this study, caution should be exercised when using data gathered under only one set of analyses. Further, it is strongly recommended that personnel trained in bioarchaeology or physical anthropology are needed in both stages of analysis to maximize the data returns.

The Olduvai Hominid 8 foot reconsidered : a new architectural analysis. G. BERILLON, Institut de Paléontologie Humaine, Paris, France.

Olduvai Hominid 8 (Tanzania) is the best preserved plio-pleistocene hominid foot skeleton. But, as Kidd *et al.* (1996) pointed out, rare are the studies of the whole skeleton. Its architecture, studied from rearticulations, is not well defined and still often discussed, and its taxonomic attribution stays uncertain.

A new architectural analysis of the primate foot has been carried on from dislocated skeletons. This analysis is based on the angular study of the tarsus and metatarsus, and built from the principle of maximum coaptation (closed pack position). In these conditions, the foot architecture is clearly related to the articular surfaces orientation which can be measured on isolated bones. If the skeleton is complete or almost complete as in OH8, this analysis allows us to reconstitute first its main architectural features and second the way the architecture is built.

This methodology has been applied to the OH8 foot and results are compared to those obtained on the isolated plio-pleistocene hominid remains from Hadar (Ethiopia) and a sample of 43 *Homo*, 36 *Pan* et 38 *Gorilla*. It appears that the OH8 architecture clearly differs from both african great apes and australopithecine ones. This foot shows a plantar vault with two longitudinal arches, a transverse arch at the level of the proximal portion, and parallel metatarsals. This configuration is very similar to the bipedal modern

human one and leads us to attribute this specimen to the genus *Homo*.

This work was supported by the CNRS, France.

Positional behavior and prehensile-tail use in *Alouatta palliata*. M.F. BEZANSON, Department of Anthropology, University of Arizona, AZ 85721.

Efficient movement in the arboreal canopy presents challenges that are influenced by body size, anatomy, and grasping capabilities. In the Atelidae and *Cebus*, the prehensile tail presents a solution for distribution of weight in the arboreal canopy. Prehensile tails in these Neotropical primates function as a fifth limb for support and balance during feeding, rest, travel, and social behaviors in the forest canopy. In this study, I examine prehensile-tail use associated with positional behavior, activity, and habitat utilization. I focus on the nature and extent of prehensile-tail use and the relationships among forest structure, resource location, and positional strategy in mantled howlers.

Alouatta palliata was observed during December 1997-January 1998 and July-August 1998 at Estacion Biologica de Ometepe, Isla de Ometepe (11°24'N and 85°30'W), Nicaragua. Systematic quantitative behavioral data were collected utilizing instantaneous focal animal sampling in two-minute intervals. Data were collected on positional behavior (following the methods of Hunt *et al.* 1996) and details of tail-use within behavioral and arboreal contexts. *Alouatta* was observed for 122 hours totaling 3662 activity records. In addition, 18 external measurements were collected on 11 tranquilized howlers to provide metrical information on limb proportions and hand, foot, and tail dimensions.

Results show that the majority of feeding and foraging activities consisted of sit (65.5%), tail suspend (11.3%), horizontal tripod (8%), and tail/hindlimb suspend (6%). Tail-assisted postural modes totaled 91.3 % of *Alouatta* feeding and foraging behavior. Suspensory positional modes in which the prehensile tail provides equal or greater weight-bearing than any single limb totaled 26.6%. The tail was observed wrapped around the substrate (nonsuspensory) for additional support and balance during 64.7% of the feeding and foraging observations. During rest (sit and lie postural modes), the tail was observed wrapped around the substrate 56.4% of the time. Travel consisted primarily of quadrupedal walk with no tail assistance. The tail was utilized as a weight-bearing fifth limb during 9.1% (bridge and inverted quadrupedal walk) of all travel. These results illustrate that the prehensile tail is utilized in two major contexts: 1) as a fifth limb in suspensory weight-bearing postural modes during feeding and foraging, and; 2) in support and balance during nonsuspensory postural modes. Additional relationships among *Alouatta* positional behavior, limb proportions, and substrate preferences are discussed.

Cognitive aspects of foraging in tamarin single- and mixed-species troops (*Saguinus imperator* and *S. fuscicollis*). J.C. BICCA-MARQUES and P.A. GARBER, Department of Anthropology, University of Illinois, Urbana, IL 61801.

Primate species that form stable mixed troops are characterized by considerable overlap in diet, ranging, and patterns of habitat utilization. Less is known regarding the

cognitive basis of foraging decisions among individuals in mixed-species troops, and the degree to which species-specific differences in diet are related to differences in the use of spatial information and perceptual cues to locate resources. In this paper, we compare the performances of wild troops of emperor (*Saguinus imperator*) and saddleback (*S. fuscicollis*) tamarins in experimental foraging tasks designed to analyze their ability to use sensory cues, and spatial and quantity information in selecting feeding sites.

An experimental field study of cognitive aspects of foraging was conducted on tamarin mixed-species troops at the Parque Zoobotânico, a 100 ha protected research facility administered by the Federal University of Acre, Rio Branco, Brazil. The area is characterized by the presence of low secondary forest in various stages of succession. Our research design included the construction of four Feeding Stations located 58 to 256 meters apart in the home range of each study troop. A Feeding Station consisted of 8 visually identical feeding platforms located in a circular arrangement. In all test settings, 2 platforms at each Feeding Station were baited with a food reward (banana) and the remaining 6 platforms contained a sham reward. Data are presented on 1296 visits to these platforms by individually marked members of 2 *S. fuscicollis* and 2 *S. imperator* study groups.

Both emperor and saddleback tamarins relied more on visual cues and spatial information than on either olfactory or associative cues to select feeding sites. There was, however, evidence of species differences in the efficiency of locating baited platforms in and out of association. Emperor tamarin group 1A improved its performance under all experimental conditions when in association with saddleback tamarins ($T=0$, $n=8$, $p=0.01$) compared to when foraging as a single-species group. In 5 out of 7 experimental conditions, the increase in performance occurred when the emperor tamarin group visited the feeding platforms AFTER saddleback tamarins had already begun to forage. This suggests that these tamarins may learn and obtain information from the saddleback's recent foraging experience and use this information to more efficiently exploit food resources. Additional relationships between tamarin foraging decisions and the costs and benefits to each species of associating are discussed. Supported by funds from FBNP, WWF-Brasil, ASP, CLACS/UTUC, and CAPES.

Biomechanical Analysis of the Human Superior Pubic Ramus, with Implications for Neandertal Pubic Morphology. M.T. BLACK, Dept. of Biological Anthropology and Anatomy, Duke University, Durham, NC 27708

Researchers have long recognized a unique morphological pattern among Neandertal superior pubic rami. Neandertal rami are both absolutely and relatively longer than those of modern humans, they evidence a "reversed" pattern of sexual dimorphism in length, and they are relatively thinner than those of modern humans. Unfortunately, published cross-sectional data on Pleistocene and recent human superior pubic rami are limited to single external contour tracings at an ill-defined plane on four modern and four archaic *Homo sapiens*.

In this study, a larger number ($n=40$) of modern human superior pubic rami were CT scanned in a standard, well-defined orientation. CT sections were made every 1.5 mm along the entire length of the superior pubic ramus and the resulting films were digitized for further shape analysis. Trabecular orientation was obtained through CT sectioning and by plain film radiography of the pubic body. Previous

radiographic and gross morphological observations suggested that the superior pubic ramus could be modeled as a thin-shelled structure. Instead, CT analysis revealed the ramus to be as much as 65% occluded with cortical bone on some sections.

Proximally, cortical bone is especially thickened along the ventral rim and along the pelvic aspect of the ramus, and the major axis of the ramus is elongated towards these two margins. Both of these observations are consistent with an increased medio-lateral bending resistance proximally. Distally, the ramus is elongated supero-inferiorly towards the pubic body, and the trabeculae demonstrate a preferred orientation in this same direction. Both of these observations are consistent with a supero-inferior preferred loading axis distally.

These two orthogonal preferred loading planes, combined with a gross examination of the modern human pubis, suggest that the human pubis is composed of two interdependent biomechanical elements. Traditional cross-sectional outlines have been taken at the confluence of these two elements. Sections of Neandertal rami taken at this location differ from those of modern humans because of the increased distance between the two elements in Neandertals.

Supported in part by an N.S.F. graduate research fellowship and a Duke C.I.S. international travel grant.

Mapping quantitative trait loci influencing normal human variation: the genetics of skin reflectance. J. BLANGERO¹, L. ALMASY¹, R. DUGGIRALA², S. WILLIAMS-BLANGERO¹, P. O'CONNELL², and M.P. STERN². ¹Southwest Foundation for Biomedical Research, San Antonio, TX 78227, and ²The University of Texas Health Science Center San Antonio, San Antonio, TX.

Recent advances in statistical genetic methods are making it possible to localize genes influencing normal human quantitative variation for the first time. In this paper, we review the powerful variance components framework for the analysis of human quantitative trait loci (QTLs). This method is based on classical quantitative genetic models and has been shown to provide remarkably robust results even when the assumptions of the underlying model are grossly violated. The variance component method can be used on human pedigrees of arbitrary size and complexity. It also provides a very flexible modeling framework that allows for multiple loci influencing a phenotype and for such complications as epistasis and genotype-by-environment interaction. Additionally, we develop a simple Bayesian model selection approach to the evaluation of multiple locus models and show how Bayesian model averaging can be used to obtain more reliable estimates of QTL effect sizes.

As an example of QTL analysis for an anthropologically relevant trait, we provide an analysis of the genetic determinants of skin reflectance in large Mexican American families. Skin reflectance was obtained at three wavelengths using a Photovolt spectrophotometer. A genome scan was performed using microsatellite markers placed at a density of approximately 10-15 cM. Oligogenic multipoint linkage analysis

was performed using the variance component method, as implemented in our general computer program *SOLAR*. Our results reveal strong evidence for several QTLs influencing skin reflectance. The largest of these is located at a major candidate locus, tyrosinase, which is implicated in several forms of albinism. These results clearly indicate the potential for modern linkage analysis to find and characterize the genes influencing normal human variation.

Supported in part by NIH grants DK42273 and DK47482.

Genetic diversity and the occurrence of elevated blood pressure levels: A model system for genetic and demographic interactions. E. BOERWINKLE, Human Genetics Center and Institute of Molecular Medicine, University of Texas-Houston Health Science Center, Houston, TX 77225.

Elevated blood pressure levels are a major risk factor for cardiovascular, renal and cerebrovascular diseases. There is marked variation in the distribution of blood pressure levels and the frequency of high blood pressure among diverse populations. Numerous studies have demonstrated a role for genetic factors underlying interindividual blood pressure variation, but the identity and characteristics of the contributing genes remains shrouded in uncertainty.

We have used modern methods of genomic analysis to localize genes contributing to interindividual blood pressure variation in several populations. Multiple regions have been identified, thereby supporting the polygenic nature of blood pressure levels and control. The regions identified contain genes whose influence on blood pressure regulation is well-established, such as the adrenergic receptors and components of the renin angiotensin system. In addition, there are regions in which there are no obvious candidate genes. Importantly, our data support the notion that the effects of genes are not the same in all individuals, but rather are dependent on the context in which they are expressed – such as gender, age, population and environment.

Direct DNA sequence analysis of candidate genes within the linked regions identifies multiple single nucleotide polymorphism that may be influencing interindividual blood pressure variation. Sorting among these sites to identify which ones or which combination of sites has a functional influence on blood pressure levels remains one of the greatest challenges facing contemporary human geneticists.

The social behavior of wild *Saimiri sciureus sciureus* in Suriname. S. Boinski, Department of Anthropology and Division of Comparative Medicine, University of Florida, Gainesville, FL 32611-7305.

Although squirrel monkeys, *Saimiri sciureus sciureus*, originating from northern South America are among the most common primates in captivity, little is known of their social behavior in the wild. The first detailed observations of wild *S. s. sciureus* social behavior come from a continuing study of two troops in Raleighvallen, Suriname. Males are dominant to females in this population, consistent with captive behavioral studies. Other prominent features of this population's social organization in the wild, however, are not predicted from captive studies. Particularly noteworthy are high levels of vicious, within-troop aggression in wild troops, much of it in the context of food competition. The close male-male bonding and the weak female-female affiliation found in the wild troops are also not evident in captive groups.

These results, together with the completed field studies of squirrel monkeys in Costa Rica (*S. oerstedii*) and Peru (*S. boliviensis*), further emphasize the striking variation in social organization within the genus *Saimiri*, probably the most diverse among all primates. Caution is urged in incorporating squirrel monkey data into comparative models; data from multiple populations are often confounded. Another concern is that the behavior of hybrid or misidentified squirrel monkeys studied in captivity may be misinterpreted.

Neonatal line thickness and delivery at Isola Sacra (2nd-3rd cent. AD, Rome, Italy). L.BONDIOLI and R.MACHIARELLI, National Prehistoric Ethnographic "L.Pigorini" Museum, Rome, Italy.

The paleobiological study of the human odontoskeletal series from Isola Sacra – a necropolis used by the inhabitants of *Portus Romae* during the 2nd-3rd century AD – is aimed at the comprehensive reconstruction of the biocultural adaptations of this population and encompasses, among other studies, the histological analysis of the dentition.

The birth process leaves its mark on human enamel in the form of a birth ring, called the neonatal line (NNL). Eli and coauthors (1989) demonstrated a good correlation between mode of parturition and NNL thickness.

In order to infer the relative occurrence of "normal" vs. "operative" delivery, a sample of 209 deciduous teeth belonging to 109 individuals (age at death ranging between 6 months and 9 years) was used. NNL thickness was measured at three sites for each tooth on the buccal side.

No significant differences in NNL thickness were found between tooth classes and a good consistency was observed among antimers. The distribution of the observed thickness (mean=16.7 μ m, sd= 4.4) is slightly bimodal (15.5 and 19.5 μ m, respectively) and constitutes 95% of the observations in the range given for "normal" delivery. No correlation was found between age at death and NNL thickness.

All microscopic images, measurements and data are currently available on CD-ROM [Digital Archives of Human Paleobiology (DAHP), N.1].

Supported by the Italian National Research Council (CT 15, "Cultural Heritage" Project).

Mammalian genetics and Neandertal morphology. E.J. BOWERS-BIENKOWSKI, Anthropology, Ball State University, Muncie, IN 47303

Neandertal morphology, particularly that of the head and face, is distinct from that of other fossil hominids from other times or places. Morphology is the reification of metabolism, and metabolism is directed by the genes. Recent studies of the evolution of development indicate substantial homology of the genes involved among mammals, as well as at greater phylogenetic distances. This paper reviews some of the genes involved in mammalian development and metabolism, alleles of which have the potential for explaining Neandertal morphology. Three areas are considered: the musculo-skeletal system, the development and regulation of the function of the thyroid gland which is involved in cold adaptation, and the face. Alleles affecting the musculo-skeletal system include that for double muscling, long known in cattle and recently reported in mice and humans; and the allele, recently reported in obesity studies, which dissociates mitochondrial production of ATP and heat. In the area of thyroid function, variation in thyroid hormone carrier protein (the product of an X-chromosome gene), and thyroid

stimulating hormone from the pituitary, and its hypothalamic releasing hormone, are considered. In the face, genes expressed in the olfactory placodes and their developmental fields are examined, since these include the nasal structures and the premaxilla. This paper synthesizes knowledge of developmental, and metabolic genetics with what is known of Neandertal morphology. By so doing it opens new approaches to questions regarding the affiliation and evolutionary fate of the Neandertals.

A regional perspective on the skeletal manifestations of slavery. D.C. BOYD and C.C. BOYD, Department of Sociology and Anthropology, Radford University, Radford, VA 24142.

In a recent AAPA paper, Steckel et al. (1998) note high levels of stress and generally poor health for many African-American slave populations across the Western Hemisphere. In our paper, a population of nearly 50 early 19th century African-Americans from Henrico County cemetery near Richmond, Virginia, is discussed in terms of skeletal expressions of slave life and death in historic eastern Virginia. Traditional skeletal indicators of health, nutrition, disease and stress (such as porotic hyperostosis, enamel hypoplasia, degenerative joint disease, infectious lesions, and demographic data) are discussed and compared to other historic African-American skeletal samples from eastern Virginia and beyond. Comparisons of Henrico County cemetery slaves with osteological data from slaves across the Western Hemisphere define a temporal and regional context for these historic Virginians and allow evaluations of biological responses to specific ecological and cultural conditions facing them during the early 19th century. This research provides a new glimpse into potential biological correlates of African-American slavery, a heretofore little known aspect of Virginia skeletal biology.

Skin Color as an Index of Timing in Human Evolution. C. L. BRACE, University of Michigan, Ann Arbor, MI 48109, M. HENNEBERG, University of Adelaide, South Australia, J. H. RELETHFORD, State University of New York, Oneonta, NY 13820.

Variation in skin color is one of the most obvious indices of the intensity and duration of the forces of natural selection on human appearance. Melanin prevents the penetration of the carcinogenic portion of solar radiation — particularly the B-range ultraviolet rays. Maximum amounts of epidermal melanin occur in human populations that have resided in the tropics for a prolonged period of

time. The duration of residence of human populations at different latitudes should provide an index of the time needed to produce the observed differences in human skin color..

The terminal Pleistocene spread of people of Northeast Asian origin into the western hemisphere represents a key test. Despite a rapid spread from the Arctic Circle to within ten degrees of Antarctica, evidently a time depth of 15,000 years is not sufficient to have had any significant impact on gradients in human skin color. The Australian case shows that a time depth of over 50,000 years and a range of latitude that extends from well north of the Tropic of Capricorn to that of Buenos Aires is sufficient to show the beginnings of a north-south gradient.

Using these examples as a guide and correcting for the differences in the gradient of ultraviolet ray intensity over comparable ranges of latitude in the northern and southern hemispheres, it is possible to suggest that it required well over 100,000 years of residence *in situ* to produce the degree of skin pigment characteristic of northern China. For the same reason, it can be predicted that it took approximately 200,000 years of *in situ* residence at the latitude of London, Berlin and Kiev to have produced the degree of pigment characteristic of the people who continue to live there today. The available archaeological evidence supports the picture of habitation in those areas consistent with the scenario of *in situ* pigment change suggested here.

The Taung child: a re-assessment of its age at death from skull base maturation evidence. J. BRAGA and P. MURAIL, UMR 5809 CNRS, Department of Anthropology, University Bordeaux I, Av. of Facultés, 33405 Talence cedex, FRANCE

In 1925 Dart published the first account of the skull of a fossil child discovered close to the Tswana village of Taung in the northern Cape Province. He assigned the specimen to a new species and genus, *Australopithecus africanus*. Since Dart's discovery, many Plio-Pleistocene hominid juveniles have been found. These findings entailed the study of the developmental history of early hominids. Indeed, the patterns of somatic growth have been interpreted by examining the rates and patterns of dental development but skull growth and development has until now received relatively little attention in the paleoanthropological literature. The Taung child evinces erupted first permanent molars into occlusion and central incisors with little or no root formed yet. Depending on the eruption schedules and calcification sequences used (respectively, common chimpanzees and extant humans), some authors believe that it was not more than 3-4 years of age, others propose an older age of 5-6 years.

In the present study, we report the timing and pattern of closure of the anterior intra-occipital synchondrose in extant humans originating from

Europe, America and Africa, within age limits of 1 up to 6 years. Moreover, for the first time, equivalent data on wild common chimpanzee skeletons of known age at death are provided. From these original data, we suggest that the estimated age at death of the Taung child is not more than 4 years.

We believe that this finding provides significant new insights into the cognitive abilities and biology of early hominids. Indeed, detailed comparisons of skeletal maturation between extant humans and chimpanzees (both common and pygmy) provide useful landmarks to explore the developmental history of early hominids but also to assess their age at death.

Tooth wear and diet. K. L. BRANDT, State University of New York at Albany, Department of Anthropology, Albany, New York 12222 and B. H. SMITH, University of Michigan, Museum of Anthropology, Ann Arbor, MI 48109.

Tooth wear is an important clue to past subsistence and food processing methods. The depth to which exposed dentin wears relative to bordering enamel has rarely been measured, but has potential value for reconstructing diet in prehistoric human populations. Depth of dentin exposure (sometimes referred to as "cupping") is thought to reflect amount of grit, food texture, and the type and amount of chewing (Costa and Greaves, 1981, JP 55:635; Brandt, 1994, AJPASup 16:34).

Three well known prehistoric human populations were selected for data collection and analysis because it was thought that they would span the human range in depth of dentin exposure: prehistoric Nubians (N=17), Australian aborigines (N=53), and Eskimos (N=60). A fourth group, prehistoric Michigan natives (N=193), in which food preparation is less well understood, is compared to the others. Depth of dentin exposure is measured with a depth gauge to 0.1 mm on the protocone and protoconid of first and second molars. Depths are compared after matching molars for overall degree of wear.

Nubians, Australians and Eskimos represent greatly different climates, lifeways, and diets. Their dentin exposures, however, differ in a predictable fashion if maximum depths are produced by high grit and relatively finer chewing motions. Thus, Nubians, with a diet of stone ground grains, develop deeply cupped dentin wear, whereas Eskimos, with a diet of lightly prepared meat, show virtually no cupping (despite a high degree of overall wear). Australian aborigines, with a somewhat gritty diet of a diverse nature, show an intermediate amount of cupping. The Michigan natives, with a mixed diet of cereal grains and wild resources, also have an intermediate amount of cupping. The similarity in depth of dentin exposures in the Michigan natives who relied on maize and those who did not, emphasizes the importance of processing techniques in influencing food texture and tooth wear.

Tooth wear is increasingly understood as a complex signal in which several different aspects of food sources and food preparation are recorded. Depth of dentin is of particular interest because it differs greatly in prehistoric human populations. Extrapolating from present results, measurement of depth of dentin exposure could help separate out, for example, terrestrial versus arboreal food sources in early hominids, or reflect changes in food sources or cooking in human evolution.